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(54) Title: DYNAMIC ALLOCATION OF RANDOM ACCESS CAPACITY IN GPRS NETWORKS

(57) Abstract: A method for dynamic allocation of capacity on a Master Packet Data CHannel (MPDCH) to a Packet Random Access CHannel (PRACH) and communication network elements implementing the method are disclosed. A network element monitors various network traffic information, from which steering parameters are determined. The steering parameters are used to determine a desired capacity allocation to the PRACH.

DYNAMIC ALLOCATION OF RANDOM ACCESS CAPACITY IN GPRS NETWORKS

BACKGROUND

The present invention relates to cellular communication networks, and more particularly to systems and methods for operating a data, or packet-switched, cellular communication network.

Public cellular communication networks (public land mobile networks) are commonly employed to provide voice and/or data communication services to network subscribers. Information is encoded as a modulated radio frequency carrier wave and transmitted across an air interface, e.g., between a cellular communication network node and one or more remote terminals. Each cell in the network typically includes at least one base transceiver station (BTS) which is managed by a base station controller (BSC). The network's base station controllers are connected via control nodes to a core telecommunications network. Examples of control nodes include mobile services switching center (MSC) nodes for connecting to connection-oriented, circuit switched networks such as PSTN and/or ISDN, and general packet radio service (GPRS) nodes for connecting to packet-switched networks such as the Internet.

A cellular telephone is one example of what is referred to as a "remote terminal", "mobile station", or "mobile terminal". Other examples of remote terminals include personal computers (PCs), personal digital assistants (PDAs), pagers, etc. Some remote terminals are capable of running multiple applications, such as, for example, Internet browsers and electronic mail programs. Several multimedia applications may reside in the same remote terminal.

Cellular communication systems employ various modes of operation (e.g., analog, digital, dual mode, etc.), and various access techniques such as frequency

division multiple access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA), or hybrids of these techniques. In an FDMA system, communication signals are transmitted as modulated waveforms over separate frequency bands in a spectrum of carrier frequencies. The frequency bands serve as communication channels over which remote terminals communicate with the network. In the United States, for example, Federal authorities have allocated to cellular communications a block of the UHF frequency spectrum further subdivided into pairs of narrow frequency bands, a system designated EIA-553 or IS-19B.

A TDMA system may be implemented by subdividing the frequency bands employed in conventional FDMA systems into successive time slots, and a communication channel typically includes one or more time slots in one or more frequency bands. The time slots are usually organized into successive frames, each of which includes a plurality of discrete time slots. Examples of systems employing TDMA include the digital advanced mobile phone service (D-AMPS), some of the characteristics of which are specified in the TIA/EIA/IS-136 standard published by the Telecommunications Industry Association and Electronic Industries Association (TIA/EIA) and in the European Global System for Mobile Communication (GSM) standard. In these TDMA systems, each user communicates with the base station using bursts of digital data transmitted during the user's assigned time slots.

A third channel access technique is Code Division Multiple Access (CDMA). By contrast, CDMA systems allow user communications to overlap in both time and frequency; channels are defined by unique codes assigned to users. In a CDMA system, an electrical signal embodying an informational data stream (e.g., digitized voice, data, video) to be transmitted is combined with an electrical signal embodying a higher bit rate data stream referred to as a signature sequence, or spreading sequence, to produce a spread spectrum signal. The information required

to decode the spread spectrum signal (e.g., the unique signature sequence) may be transmitted to an intended receiver over a separate communication channel (e.g., a pilot channel or a control channel). Using this information, the intended receiver can extract the informational data stream from the spread spectrum signal, thereby establishing a communication channel with the transmitter.

General Packet Radio Service (GPRS) is a relatively recent data service designed to operate with TDMA networks, including GSM networks. GPRS is a packet-switched data transmission protocol capable of transmitting data packets over an air interface at transmission rates up to 115 Kbps. Packet-switched networks are to be distinguished from circuit-switched networks. A circuit-switched network maintains a continuous connection between a remote terminal and a network during a communication session. In contrast, a packet-switched network establishes a connection between a remote terminal and the network only when either (1) the remote terminal desires to transmit data to the network, or (2) the network has data to transmit to the remote terminal. In other words, in GPRS the remote terminal is connected to the network only when information is being transmitted or received.

GPRS networks transmit data and control signals in separate channels. GPRS networks use a Master Packet Data Channel (MPDCH) to transmit control signaling and data signaling. For the uplink (e.g., for data transfers from the remote terminal to the base stations), the capacity of the MPDCH is dynamically shared between channels for control signaling and channels for data signaling. Control signaling includes data control information, e.g., information related to the data packets being transmitted, and is transmitted on a Packet Data Traffic Channel (PDTCH) and its associated Packet Associated Control Channel (PACCH). Access requests are requests by a remote terminal to reserve capacity for a packet transfer, and are transmitted on a Packet Common Control Channel (PCCCH), i.e., a Packet

Random Access Channel (PRACH).

In one implementation of GPRS, allocation of capacity on the MPDCH is managed by the Medium Access Control (MAC) protocol. The MAC protocol adds an Uplink State Flag (USF) to each data and control block transmitted on the downlink (e.g. from the network to a remote terminal) PDCH. The USF indicates either that the next uplink block on the MPDCH is reserved (USF = r) for one of the remote terminals in the cell or that next uplink block on the MPDCH is free (USF = f) for any remote terminal in the cell to use. Remote terminals use a multiple access technique to vie for access to an uplink capacity on the MPDCH. To initiate a packet transfer, a remote terminal first determines whether the USF is free (USF=f), and if it is then the remote terminal transmits a random access request on a PRACH in the next time slot. By contrast, if the USF is reserved (USF = r) then the remote terminal waits until the USF is free (USF = f) to transmit a random access request.

In another GPRS implementation, random access capacity is managed by reserving a fixed number of blocks in the uplink MPDCH for random access requests, i.e., to the PRACH. Remote terminals are informed about the reservations by Packet System Information messages broadcast on the Packet Broadcast Control Channel (PBCCH). Network control software sets the USF flag to free (USF = f) for the reserved blocks to prevent the reserved blocks from being used for the PDTCH, or for the transmission of data from the remote terminal.

Accordingly, there is a need in the art for systems and methods for allocating capacity to random access requests in an efficient and effective manner.

SUMMARY

The present invention addresses these and other problems by providing methods for dynamically allocating capacity on the MPDCH dedicated to random

access requests, i.e., for dynamically allocating capacity to the PRACH. Advantageously, the present invention dynamically allocates capacity as a function of one or more system parameters to encourage the efficient utilization of channel capacity.

One embodiment of the invention is implemented in a cellular communication system that uses a control channel and one or more separate data channels for exchanging information between a base station serving a cell within the network and a remote terminal in the cell. The invention provides a method for dynamically allocating capacity on a control channel to a random access channel, comprising the steps of establishing an initial capacity allocation to the random access channel, and modifying the capacity allocated to the random access channel based on a function of steering parameters. In further embodiments, steering parameters include at least one of the frequency of uplink requests from remote terminals in the cell received by the base station, the number of packet data channels allocated in the cell, and the capacity allocated to the random access channel. In still further embodiments, the capacity allocated to the random access channel is allowed to vary between a lower limit and an upper limit.

Another embodiment of the invention is directed toward a base station controller adapted to transmit packet-switched data via a base station serving a cell within a cellular communication network. The base station uses a control channel and one or more separate data channels for exchanging information with a remote terminal in the cell, and the base station controller includes a control unit for determining at least one steering parameter and allocating capacity on the control channel to a random access channel as a function of the at least one steering parameter.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the present invention will become more apparent upon reading this description, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 illustrates a known mobile radio communication system with associated nodes connected to a packet-switching telecommunications network;

FIG. 2 illustrates a method of dividing a message into packets, blocks and data bursts;

FIG. 3 illustrates a known method of defining a specific channel in a time-divided system, such as time slots on a given frequency;

FIG. 4 is a schematic depiction of a framing structure that illustrates how channels in a time-divided radio communication system are related to TDMA frame numbers;

FIG. 5 is a schematic depiction illustrating data transmission from a base station to a remote terminal;

FIG. 6 is a schematic depiction illustrating data transmission from a remote terminal to a base station;

FIG. 7 is a flowchart illustrating the steps of a method of allocating PRACH capacity on a MPDCH in accordance with the invention;

FIG. 8 is a schematic depiction of a memory table for storing representative values of steering parameters associated with a PRACH allocation capacity variable;

FIG. 9 illustrates a control unit in accordance with an embodiment of the invention connected to a base station; and

FIG. 10 illustrates a control unit in accordance with an embodiment of the invention connected to a base station controller.

DETAILED DESCRIPTION

An overview of a GPRS network architecture is illustrated in FIG. 1. Information packets from external networks enter the GPRS network at a Gateway GPRS Service Node (GGSN) 10. A packet is then routed from the GGSN via a backbone network, 12, to a Serving GPRS Support Node, (SGSN)14, that is serving the area in which the addressed GPRS remote terminal 21 resides. From the SGSN 14, the packets are routed to the correct Base Station System (BSS), in a dedicated GPRS transmission. The BSS includes a plurality of base transceiver stations (BTS), only one of which, BTS 18, is shown and a base station controller (BSC) 20. The interface between the BTSs and the BSCs are referred to as the A-bis interface. The BSC is a GSM-specific denotation, and for other exemplary systems the term Radio Network Control (RNC) is used for a node having similar functionality as that of a BSC. Packets are then transmitted by the BTS 18 over the air interface to a remote station 21 using a selected information transmission rate.

A GPRS register holds all GPRS subscription data. The GPRS register may, or may not, be integrated with the HLR (Home Location Register) 22 of the GSM system. Subscriber data may be interchanged between the SGSN and the MSC/VLR 24 to ensure service interaction, such as restricted roaming. The access network interface between the BSC 20 and MSC/VLR 24 is a standard interface known as the A-interface, which is based on the Mobile Application Part of CCITT Signaling System No. 7. The MSC/VLR 24 also provides access to the land-line system via PSTN 26.

Prior to transmission of information between the GGSN and a remote terminal, the messages are divided into one or more packets whose lengths may vary in accordance with the load on the transmission network at that moment in time. FIG. 2 illustrates the division of a message into packets p_1-p_n. FIG. 2 also shows the division of each packet into blocks b_1-b_m, each block including a specific number of information

bits, e.g. 320 bits. If information space is left in the last block b_m when dividing the blocks, this space may be filled with dummy bits. In the transmission of information between the base station and the remote terminal, each block may be divided into four data bursts s1-s4 of equal size and each containing eighty information bits. If the radio communication system is a TDMA system, then the data bursts can be transmitted bit-interleaved in four consecutive time slots on a time divided channel.

In most digital communication systems, communication channels are implemented by frequency modulating radio carrier signals, which have frequencies near 800 megahertz (MHZ), 900 MHZ, and 1900 MHZ. In TDMA systems and even to some extent in CDMA systems, each radio channel is divided into a series of time slots, each of which contains a burst of information from a user. The time slots are grouped into successive frames that each have a predetermined duration, and successive frames may be grouped into a succession of what are usually called superframes. The particular type of channel access technique (e.g., TDMA or CDMA) used by a communication system affects how user information is represented in the slots and frames, but most access techniques use a slot/frame structure.

Time slots assigned to the same user, which may not be consecutive time slots on the radio carrier, may be considered a logical channel assigned to the user. During each time slot, a predetermined number of digital bits are transmitted according to the particular access technique (e.g., TDMA, CDMA) used by the system. In addition to logical channels for voice or data traffic, cellular radio communication systems also provide logical channels for control messages, such as paging/access channels for call-setup messages exchanged by base stations and remote terminals. In general, the transmission bit rates of these different channels need not coincide, and the lengths of the slots in the different channels need not be uniform. The set of possible transmission bit rates for a channel is typically a limited integer value and is known to both the

transmitter and the receiver which use that channel.

FIG. 3 illustrates the manner in which a specific channel in a TDMA system is defined as time slots on a given frequency in a manner known per se. In GSM, a so-called TDMA frame is comprised of eight time slots numbered from zero to seven. These time slots form eight so-called basic physical channels. For instance, fifty-two TDMA frames, numbered from zero to fifty-one, together form a multi-frame. Multi-frames are used in GSM as carriers of the so-called logic channels, for instance the packet data channels. One such logic channel is comprised of a specific time slot in each TDMA frame on a separate carrier frequency. For instance, the slave packet data channel SPDCH2 may be comprised of time slot 2 on the carrier frequency, *f*. The Figure illustrates the manner in which time slot 2 in a multi-frame corresponding to a packet data channel SPDCH2 is created from TDMA frame 0, 1 and 2 respectively on the carrier frequency *f*.

FIG. 4 illustrates a manner in which logical channels on a given carrier frequency in a TDMA system may be mapped onto a multiframe structure. The multiframe structure for PDCH includes fifty-two frames divided into twelve blocks of four frames each (B0..B11), two idle frames (indicated by an X), and two frames used for the PTCCH, (indicated by a T). Logical channels may be mapped onto the ordered list of blocks (B0..B11), for example, by using one or more parameters broadcast on the Packet Broadcast Control CHannel (PBCCH). On an uplink Packet Data CHannel (PDCH), all blocks in the multiframe can be used for the Packet Random Access CHannel, the Packet Data Traffic CHannel (PRACH), or the Packet Access Control CHannel (PACCH). Alternatively, a subset of the blocks may be used as PRACH. A remote terminal may ignore a USF = free message, or use the USF to determine the PRACH as it determines other channels. If a PDCH does not include a PCCCH, then all blocks can be used as PDTCH or PACCH.

FIG. 5 is a schematic depiction illustrating data transmission on the downlink, e.g., from a BTS to a remote terminal via time-divided radio channels. Information (e.g., data, video) from the network is divided into packets p_1-p_n, which are transmitted to the remote terminal in blocks, e.g., as described above, via one or more time-divided SPDCHs. A Master Packet Data CHannel (MPDCH) carries control and data information. The remote terminal may transmit an acknowledgment message back to the BTS indicating that the data transmission was received and whether the data includes errors. This acknowledgement message will be transmitted on the PACCH associated with the PDTCH.

FIG. 6 is a schematic depiction illustrating data transmission on the uplink, e.g., from a remote terminal to a base transceiver station BTS. Information (e.g., data, video) from the remote terminal is transmitted via time-divided slave packet data channels SPDCHs, while both data and control information is transmitted by a specific master packet data channel MPDCH. The information, consisting of data messages, is divided in the remote terminal into packets p_1-p_n, which are transmitted as blocks to the base transceiver station BTS via one or more time-divided slave packet data channels SPDCHs.

The present invention provides a method for dynamically allocating capacity to the PRACH of an uplink MPDCH, which method is illustrated in FIG. 7. To facilitate the description, the invention will be described in the context of a cell having a single MPDCH, but it will be appreciated that the cells frequently include additional PDCHs. The MPDCH could be allocated on traffic demand or could be established by the operator as a dedicated MPDCH. Also, it will be appreciated that cellular networks may dynamically increase or decrease the number of PDCHs allocated in a cell based on the amount of data traffic in the cell.

In brief overview, according to the one embodiment invention capacity on the

MPDCH is allocated to the PRACH using the method illustrated in FIG. 7. At step 710 an initial capacity allocation to the PRACH is made. Communication traffic patterns in the cell are monitored (step 715), and when a triggering event occurs (step 720) current steering parameters are sampled (step 730) and used to determine a desired PRACH capacity allocation on the MPDCH (step 740). Capacity on the MPDCH may then be allocated to the PRACH (step 750). This process is explained in greater detail below.

In one embodiment, when GPRS support is initiated in a cell, the MAC protocol initially sets the USF flag to free (USF = f) in a predetermined number of uplink blocks on the MPDCH to establish an initial allocation of capacity to the PRACH (step 710). By way of example, the MAC protocol could set the USF flag to free for all uplink blocks on the MPDCH, effectively rendering the entire uplink MPDCH available for allocation to the PRACH. When a data communication session is initiated with a remote terminal, a Temporary Block Flow (TBF) is established, and a certain amount of capacity (e.g., a number of blocks) on the MPDCH are allocated to the TBF to transmit data information. To maximize the throughput of the data communication session, it is desirable to allocate as many blocks as possible to the TBF. As additional data communication sessions are established, additional TBFs are placed on the MPDCH. Thus, capacity allocation on the MPDCH must balance the competing contentions of data overhead allocated to the PRACH.

The present invention uses a control unit associated with a network node (e.g., BTS, BSC, MSC, or other node) to manage the allocation of capacity on the MPDCH. The control unit monitors at least one, and preferably a plurality of steering parameters and, upon the occurrence of a triggering event (step 720) allocates capacity to the PRACH based on the steering parameters, or on a function of the steering parameters. In a one embodiment, the control unit monitors the frequency of uplink TBF

establishment requests during a monitoring period, the duration of which may be established by the network operator. The average frequency of uplink TBF establishment requests during a period of time (e.g, the monitoring period) may be used as one steering parameter. It will be appreciated that, in a GSM network, the control unit need not track the frequency of downlink TBF establishment requests because a remote terminal responds to the paging message associated with a downlink TBF with an uplink TBF. Therefore, counting the uplink TBFs accurately reflects the data connections established in the cell. It will also be appreciated that in networks other than GSM networks, the control unit may track both uplink TBFs and downlink TBFs.

The control unit may also monitor the number of PDCHs allocated in the cell as a steering parameter. As additional PDCHs are added, capacity allocated to control data on the MPDCH may be transferred to other PDCHs, so that a relatively larger proportion of the MPDCH is available for allocation to the PRACH.

Further, the control unit may also monitor the current amount of capacity on the MPDCH allocated to the PRACH as a steering parameter. In general, it is desirable to foster a smooth change in the capacity allocated to the PRACH. To facilitate a smooth change in capacity, the current amount of capacity allocated to the PRACH may be monitored and increases or decreases in the amount of capacity may be restricted.

In one embodiment, the control unit allows the PRACH capacity to vary between a lower limit and an upper limit. The lower limit may be selected by the network operator or may be fixed by the network equipment supplier. Assuming the PRACH capacity is allocated in blocks, the minimum value should be one block. Similarly, the upper limit may be selected by the network operator or may be fixed by the network equipment supplier. In one embodiment, the maximum number of blocks on the MPDCH allocated to PRACH capacity is 12 blocks, such the MPDCH is completely dedicated to signaling.

In one embodiment, representative steering parameters (e.g., TBF frequency, number of PDCHs, current PRACH allocation) are used to locate capacity allocation values stored in a data table in memory associated with the control unit. The representative steering parameters are used to estimate the future PRACH capacity allocation values, as illustrated in FIG. 8. When a triggering event occurs (step 720), the control unit samples the steering parameters from the system and references the memory table to determine the desired PRACH capacity allocation associated with the sampled steering parameters (step 740). In alternate embodiments the sampled steering parameters may be input to a mathematical function, the output of which represents a desired amount of capacity on the MPDCH to be allocated to the PRACH. It will be appreciated that the mathematical function may apply weighting factors to the various steering parameters to increase or decrease the relative importance of the steering parameters used to estimate the future PRACH capacity allocation. It will also be appreciated that the network operator may select one of a plurality of mathematical functions based on criteria such as, for example, network traffic conditions. After a desired amount of capacity is determined, the control unit may allocate the capacity to the PRACH (step 750).

The particular triggering event is not critical to the invention. Triggering events may include the expiration of a periodic timer, the receipt of either an uplink or downlink TBF, or other event selected by the network operator.

A control unit in accordance with the invention preferably comprises logic circuits operational on a processor. The logic instructions may be implemented as logic instructions operation on a general purpose processor associated with a network node, or as dedicated logic circuits embodied on an application specific integrated circuit (ASIC). Implementing the particular logic instructions necessary to implement the methods disclosed herein is within the skill of one of ordinary skill in the art.

The invention also implements a priority scheme to manage contention issues generated by downlink TBF requests. A download TBF will generate uplink signaling traffic as a result of the acknowledgment messages generated by the remote terminal. The response messages are sent in blocks indicated by the RRBP field of the downlink data block prompting the acknowledgment message. According to the invention, acknowledgment messages sent on the uplink are assigned priority over the random access requests, so that the USF of the block indicated by the RRBP field is not set to free (USF = f), but rather is set to a reserved value. Accordingly, even if the control unit has allocated a particular block as a free for PRACH allocation, the block is still available for signaling associated with a downlink TBF.

FIG. 9 illustrates a network architecture in which a control unit CU in accordance with the invention is connected to a base station B1. The base station B1 includes at least one transmitter and receiver unit TRX. The control unit CU is arranged in the transmitter and receiver unit TRX, so that it can monitor traffic parameters between the base station B1 and the remote terminal. Alternatively, the control unit CU may be arranged between the transmitter and receiver units TRX of the base station B1 and the antenna unit A, so as to provide a common resource for two or more transmitter and receiver units TRX. As before mentioned, the control unit CU may also be connected to a base station controller BSC1, as depicted in FIG. 10. This enables the control unit CU to control channel allocation for a number of base stations B1-B3 that communicate data with remote terminals MS1-MS5 in a manner analogous to when the control unit is placed in a base station B1 as before described.

The present invention is described above with reference to particular embodiments, and it will be readily apparent to those skilled in the art that it is possible to embody the invention in forms other than those described above. The particular embodiments described above are merely illustrative and should not be considered

restrictive in any way. The scope of the invention is determined given by the following claims, and all variations and equivalents that fall within the range of the claims are intended to be embraced therein.

What is claimed is:

1. In a cellular communication system that uses a control channel and one or more separate data channels for exchanging information between a base station serving a cell within the network and a remote terminal in the cell, a method for dynamically allocating capacity on a control channel to a random access channel, comprising:

establishing an initial capacity allocation to the random access channel; and

modifying the capacity allocated to the random access channel based on a function of steering parameters.

2. A method according to claim 1, wherein:

the steering parameters include at least one of the frequency of uplink requests from remote terminals in the cell received by the base station, the number of packet data channels allocated in the cell, and the capacity allocated to the random access channel.

3. A method according to claim 1, wherein:

the capacity allocated to the random access channel is allowed to vary between a lower limit and an upper limit.

4. A base station controller adapted to transmit packet-switched data via a base station serving a cell within a cellular communication network, the base station using a control channel and one or more separate data channels for exchanging information with a remote terminal in the cell, wherein the base station controller includes a control unit for determining at least one steering parameter and allocating capacity on the control channel to a random access channel as a function of the at least one steering parameter.

5. A base station controller according to claim 4, wherein:

the steering parameters include at least one of the frequency of uplink requests from remote terminals in the cell received by the base station, the number of packet data channels allocated in the cell, and the capacity allocated to the random access channel.

6. A base station controller according to claim 4, wherein:

a serving gateway support node is connected to the base station controller.

7. A cellular communication network adapted to transmit packet-switched data, comprising:

a serving gateway support node connected to a packet-switched network for exchanging data packets with the packet-switched network;

a base station controller connected to the serving gateway support node for exchanging data packets with the serving gateway support node and formatting packets for transmission across the cellular communication network;

a base station including one or more transceivers for exchanging information with a remote terminal in a cell of the cellular network; and

a control unit for determining at least one steering parameter and allocating capacity on a control channel to a random access channel as a function of the at least one steering parameter.

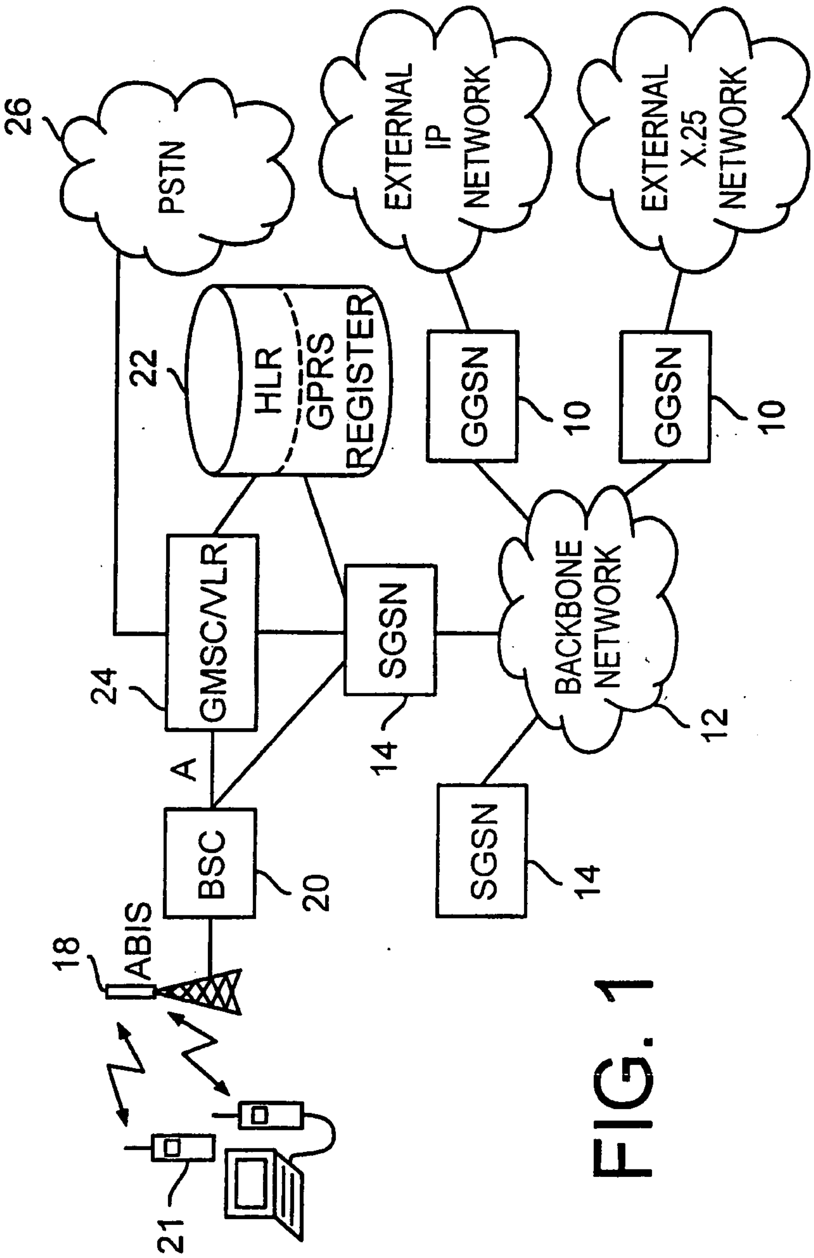

26
PSTN
EXTERNAL
IP
NETWORK
EXTERNAL
X.25
NETWORK
22
HLR
GPRS
REGISTER
GGSN
10
GGSN
10
24
GMSC/VLR
SGSN
14
BACKBONE
NETWORK
12
A
BSC
20
ABIS
18
SGSN
14
21

FIG. 1

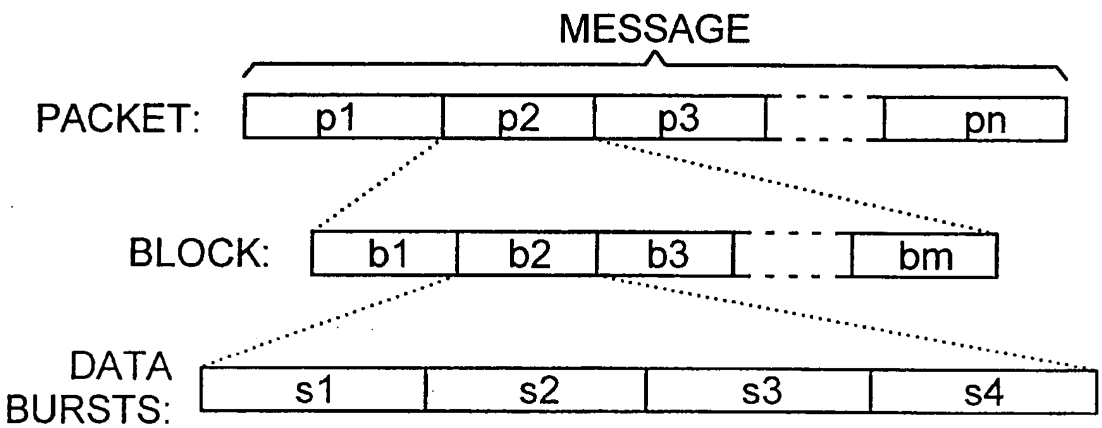

MESSAGE
PACKET:
p1
p2
p3
pn
BLOCK:
b1
b2
b3
bm
DATA BURSTS:
s1
s2
s3
s4

FIG. 2

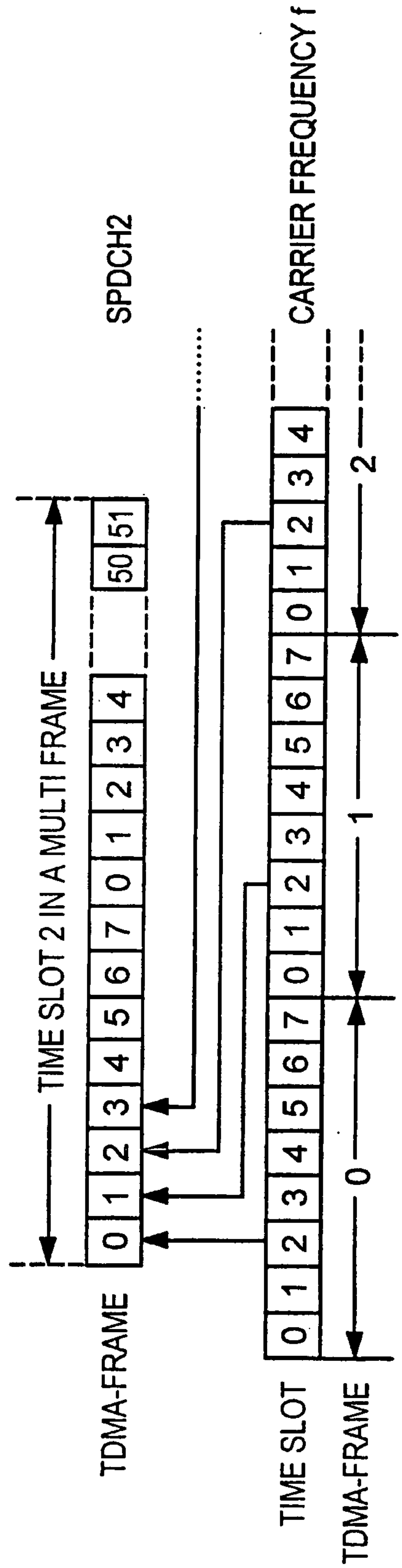
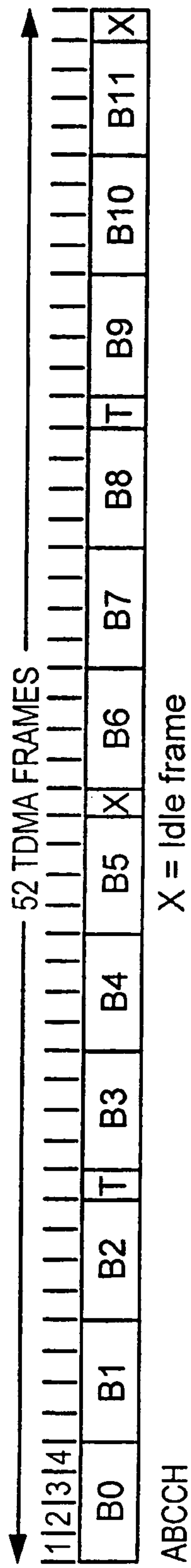

TIME SLOT 2 IN A MULTI FRAME
SPDCH2
TDMA-FRAME
0 1 2 3 4 5 6 7 0 1 2 3 4 50 51
CARRIER FREQUENCY f
TIME SLOT
0 1 2 3 4 5 6 7 0 1 2 3 4 5 6 7 0 1 2 3 4
TDMA-FRAME
0
1
2

FIG. 3



X = Idle frame
T = Frame used for PTCCH
B0 - B11 = Radio blocks

FIG. 4

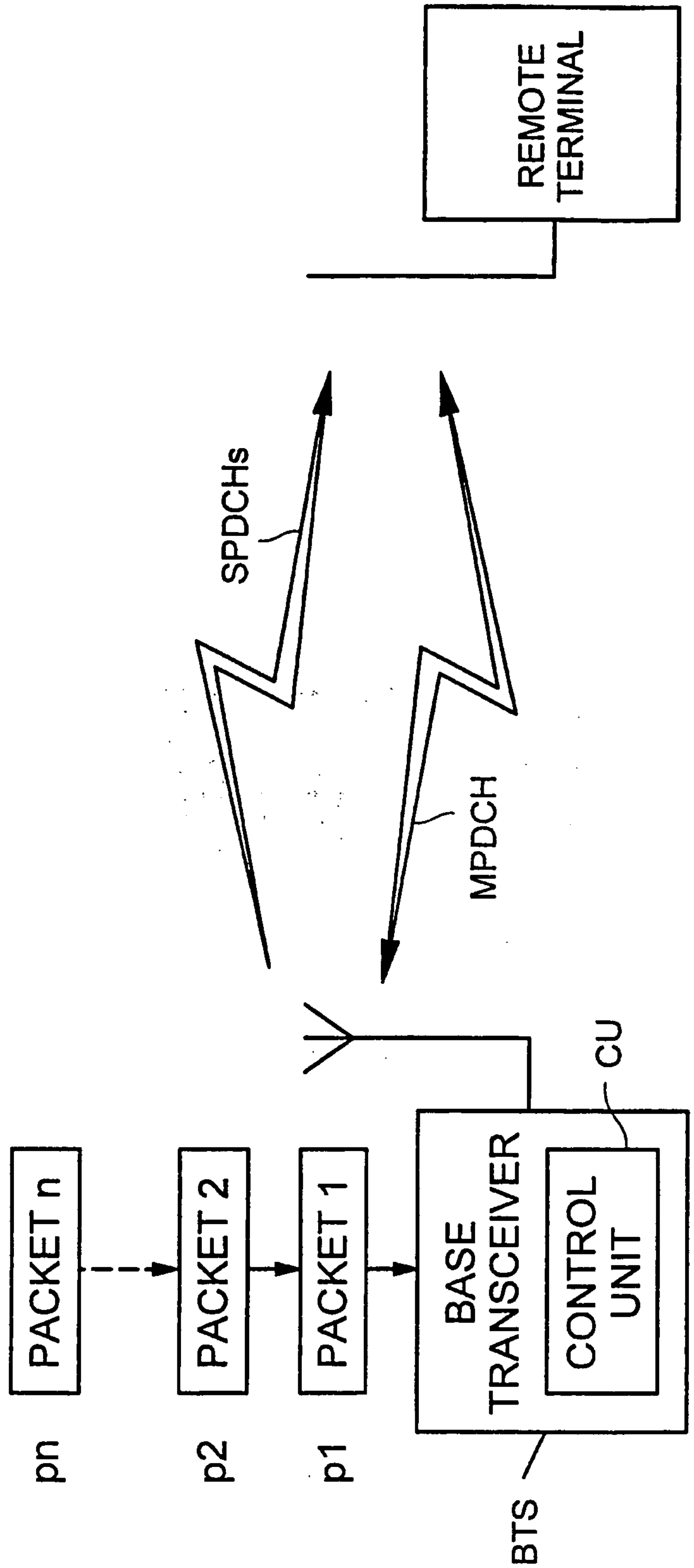

REMOTE TERMINAL
SPDCHs
MPDCH
PACKET n
PACKET 2
PACKET 1
pn
p2
p1
BASE TRANSCEIVER
CONTROL UNIT
CU
BTS

FIG. 5

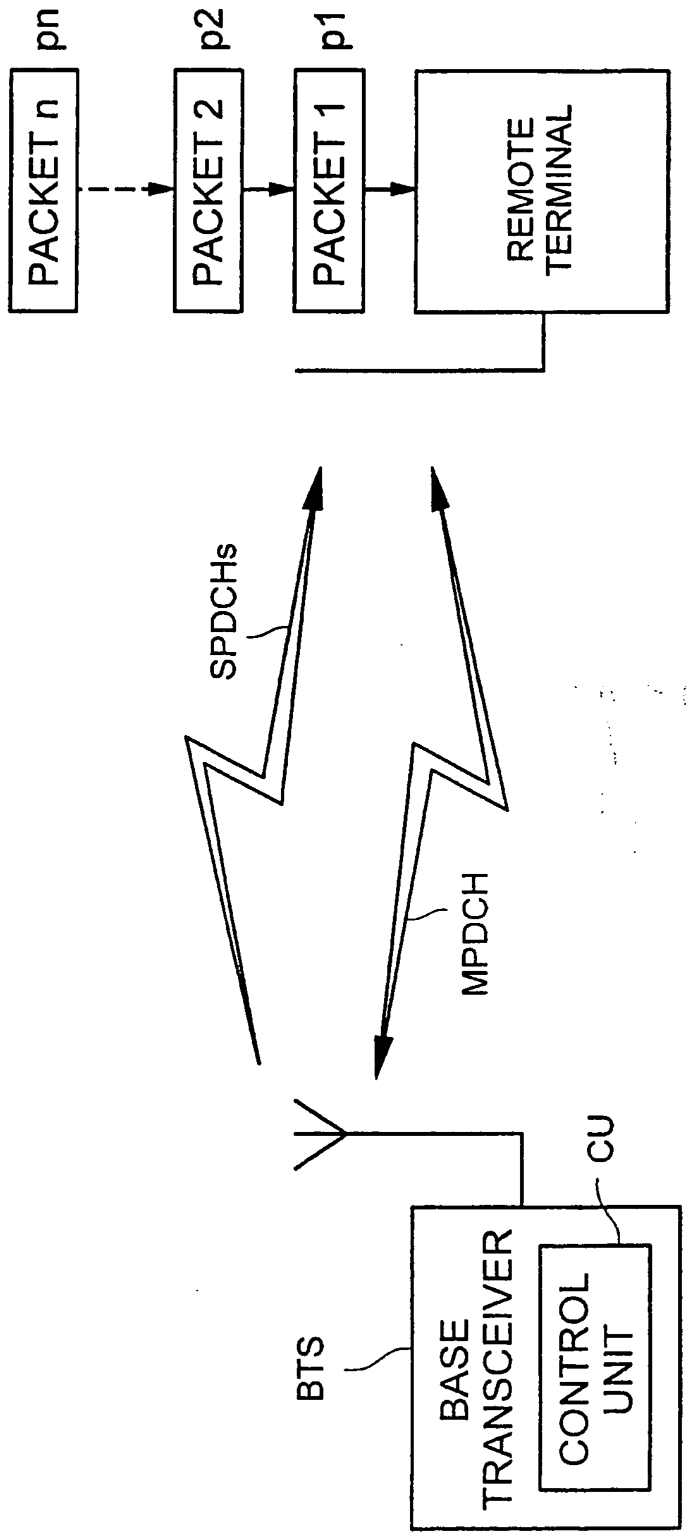

PACKET n
pn
PACKET 2
p2
PACKET 1
p1
REMOTE TERMINAL
SPDCHs
MPDCH
BTS
BASE TRANSCEIVER
CONTROL UNIT
CU

FIG. 6

FIG. 7

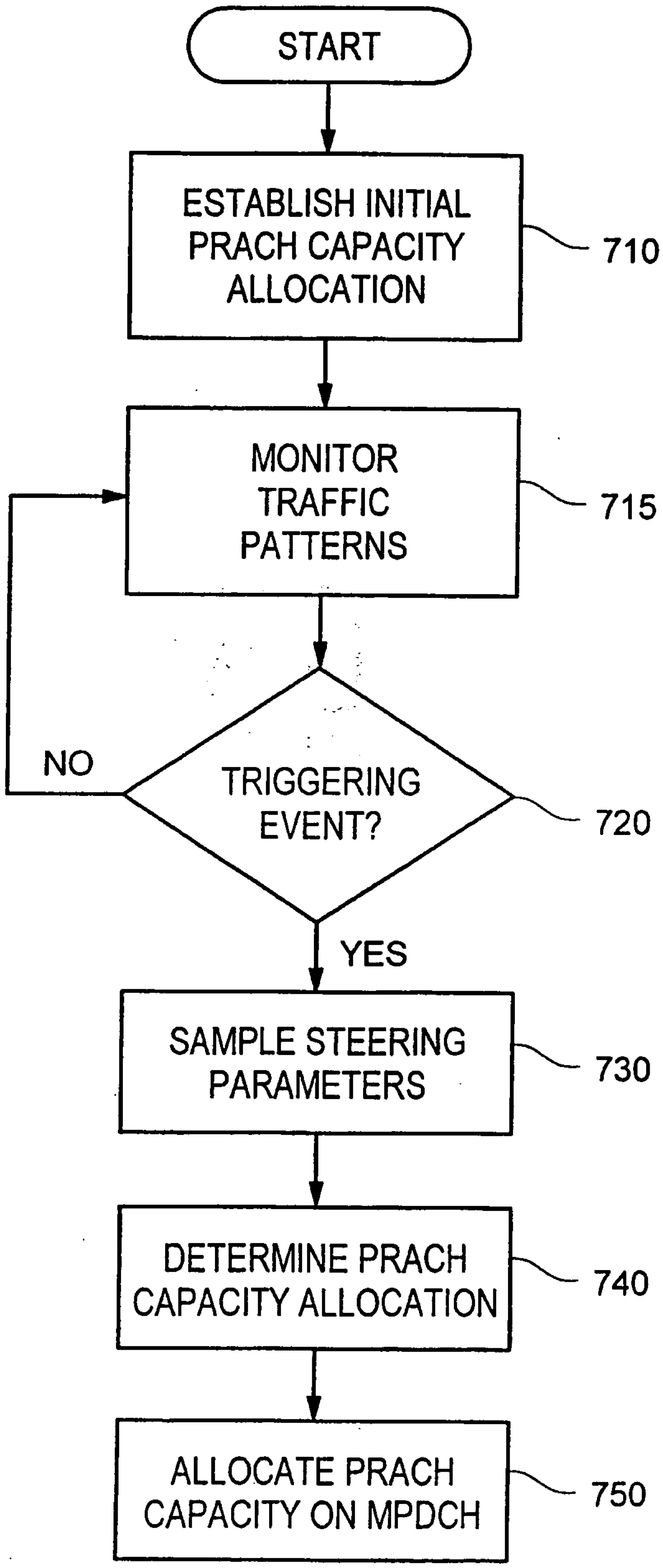
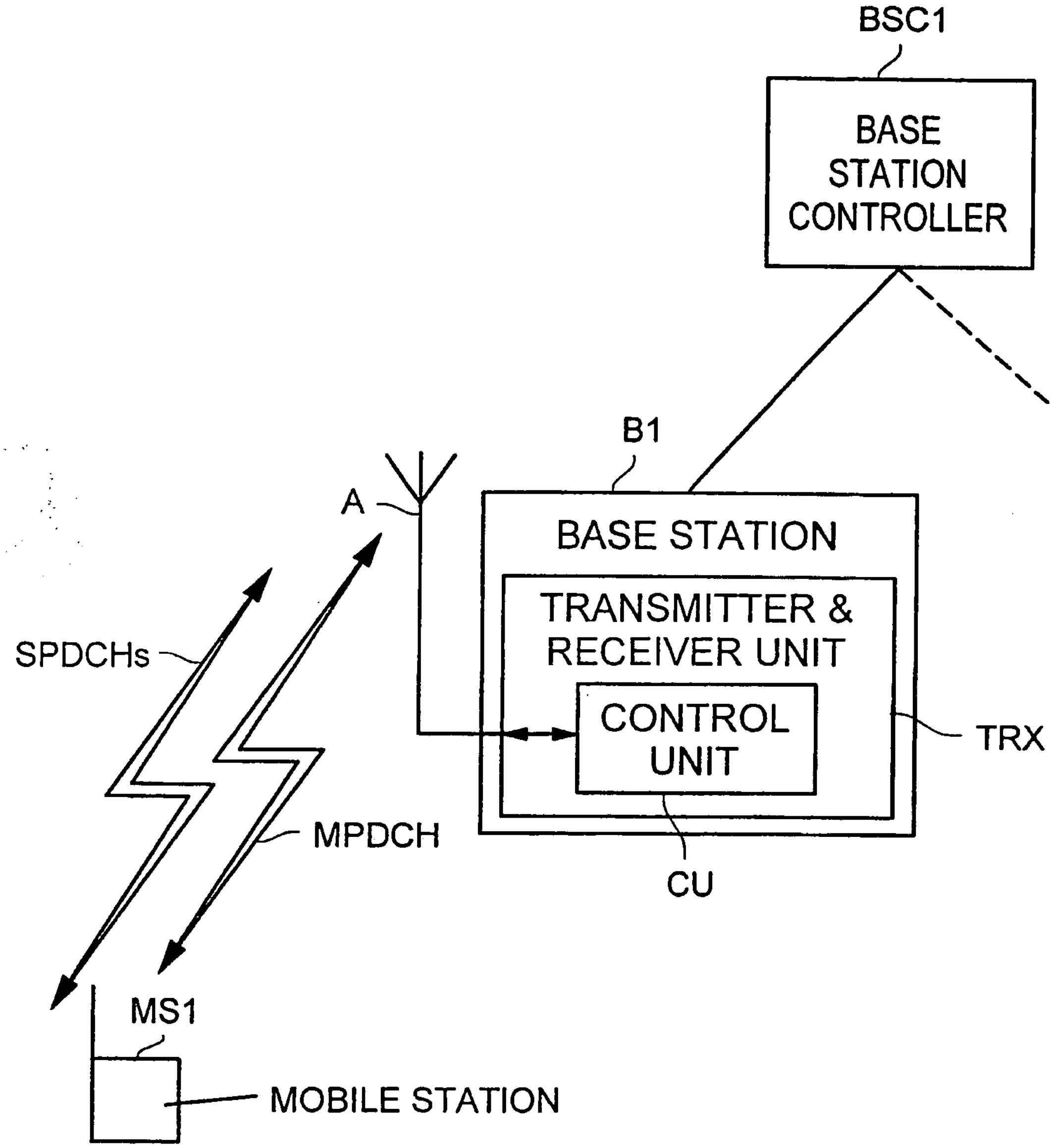

START
ESTABLISH INITIAL PRACH CAPACITY ALLOCATION
710
MONITOR TRAFFIC PATTERNS
715
TRIGGERING EVENT?
720
NO
YES
SAMPLE STEERING PARAMETERS
730
DETERMINE PRACH CAPACITY ALLOCATION
740
ALLOCATE PRACH CAPACITY ON MPDCH
750

FIG. 8

PRACH BLOCK ALLOCATION	TBF FREQUENCY	NUMBER OF PDCHs	CURRENT PRACH ALLOCATION
1	0	1	1
1	0	1	1
1	1	1	1
1	1	1	1
2	1	1	1
2	2	1	1
2	2	2	1
2	2	2	2
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
n	x	y	z

FIG. 9


BSC1
BASE STATION CONTROLLER
B1
BASE STATION
TRANSMITTER & RECEIVER UNIT
CONTROL UNIT
TRX
CU
A
SPDCHs
MPDCH
MS1
MOBILE STATION

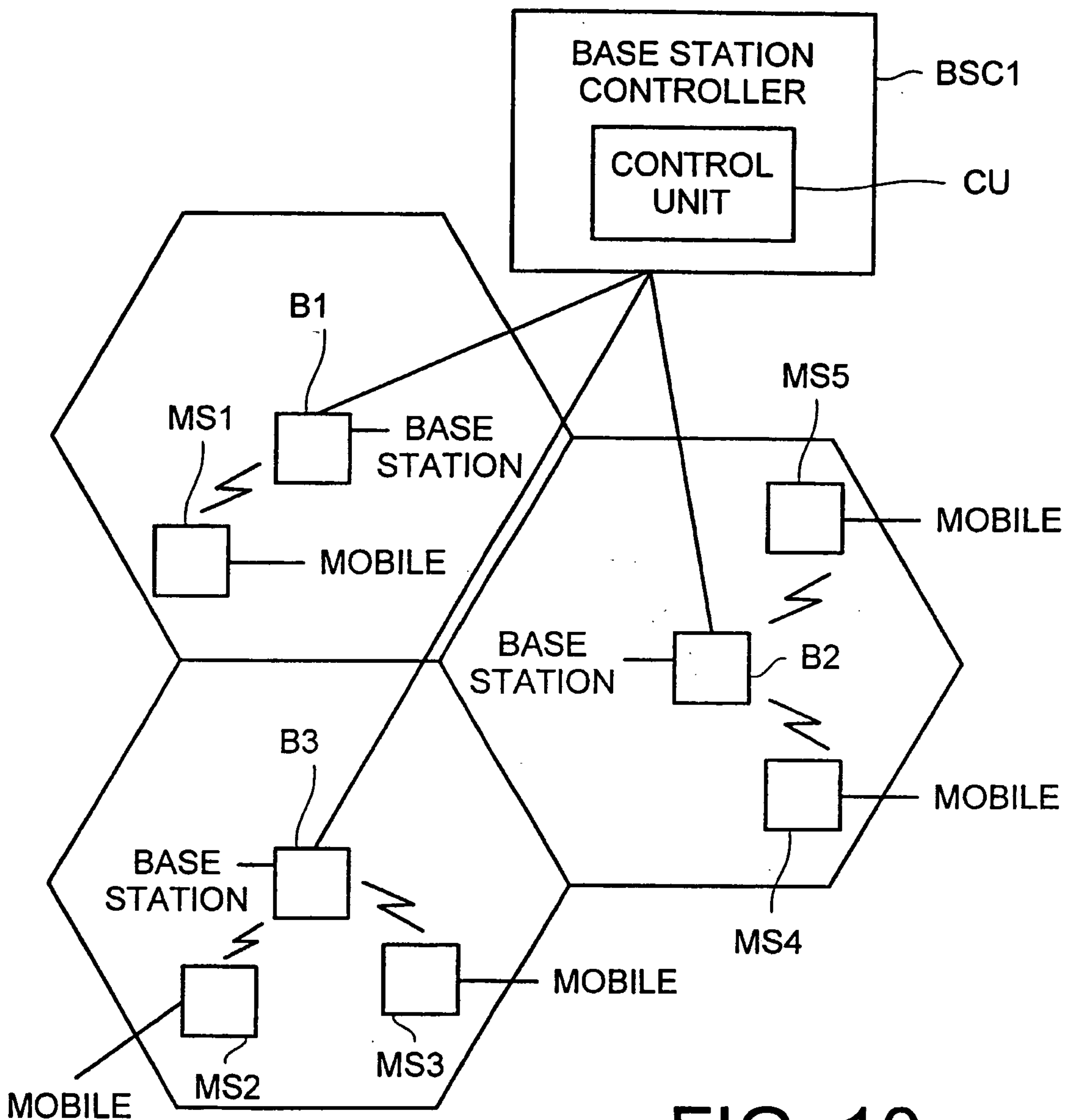

BASE STATION CONTROLLER
BSC1
CONTROL UNIT
CU
B1
MS1
BASE STATION
MOBILE
MS5
MOBILE
BASE STATION
B2
MOBILE
B3
BASE STATION
MOBILE
MS4
MOBILE
MS2
MS3

FIG. 10